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MAGNETIC RECORDING MEDIUM
[磁気記録媒体]

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SPECIFICATION

1. Title of the Invention

Magnetic Recording Medium

2. Claims

1. A magnetic recording medium wherein on a substrate there is laminated and formed either or both of a lower coated layer and magnetic layer with the magnetic layer disposed between at least one layer or more, and there is established between each layer an intermediate layer which is comprised of a thermosetting resin and a isocyanate compound which has at least 2 or more isocyanate groups.
2. A magnetic recording medium as characterized in Claim 1 wherein the thickness of the intermediate layer is in the range of 0.1 ~ 2 μm .

3. Detailed Description of the Invention

This invention is related to a magnetic recording medium of multilayer construction which laminates and forms a least one or more lower coated layer on a substrate and a magnetic layer by a magnetic layer and the like, and especially more specifically to the above-mentioned magnetic recording medium for which the smoothness of the top most magnetic layer is excellent and whose electromagnetic conversion properties are excellent.

(Prior Art)

Generally, for a magnetic recording medium that has formed a magnetic layer on a substrate of polyester film there is established a coated lower layer which includes carbon black between the medium and the magnetic layer, and there is an improvement in output by making the optical stopability or conductivity excellent, and in addition, there is established a magnetic layer with low magnetic coercive force which contains magnetic fine powder on low magnetic coercive force on the lower layer, and by laminating a magnetic layer with high magnetic coercive force with a lower layer, there is an improvement in the sensitivity or frequency characteristics in the low frequency and

high frequency bands (Japanese Kokai S60- 20316 and Kokai S55-87308).

(Problems to be Solved by the Invention)

However, there is obtained a conventional magnetic recording medium by establishing between the substrate and the top most magnetic layer a lower coated layer that contains carbon black and the like, or by establishing a magnetic layer of a lower layer with low magnetic coercive force which contains magnetic powder of low magnetic coercive force, and because there is dispersion of carbon black or solid powder such as magnetic powder within the magnetic layers of the lower coated layer and the upper layer, it is not possible to obtain sufficient improvement in surface smoothness and the surface nature of the magnetic layers of these lower layers and upper layers influence the surface of the magnetic layers which are formed by laminating on top, and there is a reduction of the surface smoothness of the magnetic layer of the upper layer, and there is deterioration of the electromagnetic conversion properties, and the same problems exist when there is lamination of 3 layers or more of the lower coated layer and magnetic layers.

(Means for Solving the Problems)

This invention is the result of accumulated research which by establishing an intermediate layer which is comprised of a thermoplastic or thermosetting resin which contains an active hydrogen containing group or hydroxyl group between every layer when laminating and forming a magnetic layer by means of a lower coated layer and magnetic layer and the like of at least one layer or more on a substrate and an isocyanate compound which has at least 2 or more isocyanate groups, and the surface nature of the magnetic layer which is the lower coated layer or lower layer using this intermediate layer effectively constrains the effect on the surface of the magnetic layer of the upper layer, and there is sufficient improvement in the surface smoothness of the magnetic layer of the topmost layer which was laminated and formed by means of the magnetic layer of these lower coated layers and lower layers, and there is sufficient improvement of the electromagnetic conversion properties.

The thermoplastic resin which contains an active hydrogen or hydroxyl group which is used in the intermediate layer of this invention has the desirable characteristics of a softening point of 150 °C or less, an average molecular weight of 100 ~ 200,000, and a degree of polymerization of 200 ~ 2000 and the thermosetting resin has the general well-known characteristics for its category. In addition, among these thermoplastic and thermosetting resins, those that are more desirably used, have neither soften nor melted up to the point of thermal cracking. These types of thermoplastic and thermosetting resins have superior film characteristics, and because these resins have active hydrogen elements or hydroxyl groups among the molecules, when used together with isocyanate compounds, there is displayed superior film characteristics, and along with the formation of an intermediate layer which has superior surface smoothness on the lower coated layer and magnetic layer which results in the lower layer, these active hydrogen elements or hydroxyl groups cross-link by reaction with the isocyanate groups within the isocyanate compound, and the strength of the coated film of the intermediate layer is sufficiently strengthened. However, the surface properties of the lower coated layer and the magnetic layer which resulted in the lower layer have no effect on the surface of the magnetic layer of the upper layer, and the surface smoothness of the magnetic layer which is formed on the topmost layer is sufficiently improved, and the electromagnetic conversion properties are improved, and the anti solvent solubility is improved. As for this kind of thermoplastic resin, it can be vinyl chloride vinyl acetate copolymer, vinyl chloride-vinylidene chloride copolymer, vinyl acrylonitrile copolymer, acetyl acrylate, ester acrylate acrylonitrile copolymer, acrylic ester acrylonitrile copolymer, acrylic ester vinylidene chloride copolymer, acrylic ester styrene copolymer, methacryl ester styrene copolymer, methacrylic ester ester styrene copolymer, urethane elastomer, polyvinyl fluoride, vinylene chloride acrylonitrile copolymer, butadiene acrylonitrile copolymer, polyamide resin, polyvinyl butyral, styrene butadiene copolymer, polyester resin, chlorovinyl ether acrylic ester resin copolymer, amino resin, synthetic gum resin of every kind, and cellulose derivatives such as cellulose

acetate butyrate, cellulose triacetate, cellulose propionate, and nitrocellulose.

In addition, as for the thermosetting resin, it is appropriate to use, phenol resin, epoxy resin, polyurethane setting type resin, urea resin, melamine resin, arylketo resin, silicon resin, acryl resin, acryl series reactive resin, macromolecular polyester resin, and polyamine resin.

In addition, in this invention, for the isocyanate compounds which have isocyanate of at least two groups which are used for the intermediate layer, the following are preferable: tolylene isocyanate, 4,4'-diphenylmethane diisocyanate, hexanemethane diisocyanate and trifunctional molecular weight isocyanate compounds which are obtained by reacting normal 1 mol triol and 3 mols diisocyanate, and for others, straight chain low molecular weight urethane resin which have at both ends separated isocyanate. These isocyanate compounds have bifunctional or trifunctional groups which are contained within the compound, and because there is 3-D cross-linking by reacting with active hydrogen containing groups which are contained in the above-mentioned thermoplastic and thermosetting resins and the hydroxyl groups, the anti solvent solubility is improved and the coating film strength of the intermediate layer is reinforced.

The amount used of the isocyanate compound which has at two or more of this kind of isocyanate group is preferably 10 ~ 40 wt. % with respect to the solid component entire weight of the intermediate layer, and if less than 10 wt. %, the cross-linking density falls, and the anti solvent ability does not improve sufficiently. In addition, when more than 40 wt. %, the intermediate coated film becomes brittle, and is easily fractured.

The intermediate layer which is comprised of a thermoplastic resin or thermosetting resin which contains active hydrogen groups or hydroxyl groups and an isocyanate compound which has at least 2 or more isocyanate groups is formed by normal methods, for example, adding other resins if necessary, prepare the coating material which is used for the intermediate layer by dissolving in an organic solvent, and form by drying the lower coated layer which was preformed on the substrate and the coated magnetic layer. In this way, the thickness of the intermediate layer which was formed in this way is the thickness after drying, and

it is preferable that that thickness be $0.1 \sim 2 \mu\text{m}$ and without obtaining the desired effect if thinner than $0.1 \mu\text{m}$, there is a problem with spacing if thicker than $2 \mu\text{m}$.

When forming the intermediate layer in this way, the organic solvent which is used is not especially limited, for example, the following can be used methylisobutyl ketone, methylethyl ketone, cyclohexanone as ketone series solvent, and ethyl acetate, butyl acetate as ester series solvents, benzene, toluene, xylene as aliphatic hydrocarbon series solvents, dioxyene, tetrahydroxyfuran, dimethylfuruamide, and dimethylsulfoxide, with all these solvents used independently or as mixtures of two kinds or more.

In addition, the coating materials which is used for the intermediate layer has a viscosity of 100 cp or less, and displays sufficient superior ability to produce a film, and the intermediate layer is produced so that it has superior smoothness, and there is no effect on the surface of the magnetic layer of the top layer from the surface nature of the lower coated layer and magnetic layer which become the lower layer, and in order to improve sufficiently the surface smoothness of the magnetic layer of the topmost layer which is formed by the existence of this intermediate layer, the viscosity should be kept to 100 cp or less. In this invention, the lower coated layer which was established on the substrate is prepared with coating materials which are used for coating the lower layer by mixing and dispersing a nonmagnetic fine powder such as carbon black together with binder components and organic solvents, and is formed by coating on a substrate of polyester film the coating material for the lower coated layer, and drying.

In addition, the magnetic layer of the lower layer when there is lamination of two or more magnetic layers is prepared by using magnetic coating material by mixing and dispersing magnetic fine powder with binder components and organic solvents, and there is coating of this magnetic coating material on a substrate such as polyester film and then drying.

In this way, there is formed a magnetic layer which includes a lower coated layer or magnetic fine powder, and after forming the above-mentioned intermediate layer on this, there is prepared for the magnetic layer which is established on this intermediate layer

magnetic coating material by mixing and dispersing magnetic fine powder together with binder components and organic solvents, and on the intermediate layer there is coating of this magnetic coating material and drying or evaporation in a vacuum was strong magnetic materials and is formed by a Tahitian on the intermediate layer using methods such as sputtering, ion plating and coating.

When forming the magnetic layer by coating the magnetic coating material and drying, it is preferable to use magnetic fine powder such as γ - Fe_2O_3 powder, Fe_3O_4 powder, γ - Fe_2O_3 fine powder which includes Co, Fe_3O_4 fine powder which includes Co, CrO_2 fine powder, Fe fine powder, Co fine powder, Ni fine powder, C-Cr alloy fine powder, Fe-Co alloy fine powder, and barium ferrite fine powder.

In addition, when forming the strong magnetic metal thin film layer using sputtering or ion plating, for the strong magnetic material which is used, the following strong magnetic metals such as Fe, Co, Ni, and others can be used as well as strong magnetic alloys such as Fe-Co, Fe-Ni, Co-Ni, Fe-Si, Fe-Rh, Co-P, Co-B, Co-Si, Co-V, Co-Y, Co-La, Co-Ce, Co-Fr, Co-Sm, Co-Pt, Co-Mn, Fe-Co-Ni, Co-Ni-P, Co-Ni-B, Co-Ni-Ag, Co-Ni-Na, Co-Ni-Ce, Co-Ni-Zn, Co-Ni-Cu, Co-Ni-W, Co-Ni-Re, Co-Sm-Cu.

[Embodiments]

Next, there is an explanation of embodiments of this invention.

Embodiment 1

Carbon black	65
wt. parts	
Hardener	18 wt.
parts	
Polyurethane resin	12
wt. parts	
Trifunctional low molecular weight isocyanate compound	
5 wt. parts	
Cyclohexanon	120
wt. parts	
Toluene	120 wt.
parts	

Prepare this coating material for the lower coated layer by mixing and dispersing using a ball mill for 72 hours this composition, and coat the coating material which is used for the lower coated layer on a polyester film of thickness 13 μm with good surface smoothness so as to form a dried thickness of 1.0 μm , and dry to form the lower coated layer.

Next, mix and disperse using a high speed stirrer the coating material composition which is used for the below mentioned intermediate layer, and so prepare the coating material for the intermediate layer, and on a lower coated layer of polyester film which formed the above-mentioned lower coated layer coat and dry this coating material for the intermediate layer so as to have a dried thickness of 0.3 μm , forming the intermediate layer.

Coating Material Composition for the Intermediate Layer

CA 310 (Moton Chemical KK, polyurethane resin)	
90 wt. parts	
Trifunctional low molecular weight isocyanate compound	
4 wt. parts	
Cyclohexanon	50
wt. parts	
Toluene	50 wt.
parts	

Mix and disperse for 48 hours using a ball mill the below mentioned magnetic coating material composition, and after mixing with a high speed stirrer for hour after having added 3 wt. parts of trifunctional low molecular weight isocyanate, prepare the magnetic coating material by passing the material through a 1 μm filter. Coat this magnetic coating material so that the dried thickness on the intermediate layer of the polyester film that formed the intermediate layer and the lower coated layer is 4 μm , and next, align process in a direct current magnetic field, and after drying by passing hot air of 100 °C, perform calendar processing. Afterwards, there is formed a video tape by slitting into 1/2 inch sheets.

Magnetic Coating Material Composition

r-Fe ₂ O ₃ which contains Co (ave. particle diam. 0.3 μm)		
100 wt. parts		
Particle-shaped α-Fe ₂ O ₃	2	wt.
parts		
α-Al ₂ O ₃	3	wt.
parts		
Zinc stearate	0.5	
wt. parts		
Hardener	8	wt.
parts		
Polyurethane resin	7	wt.
parts		
n-butyl stearate	1	wt.
part		
Myristic acid	3	wt.
parts		
Cyclohexanon	125	
wt. parts		
Toluene	125	wt.
parts		

Embodiment 2

As with Embodiment 1, but omit the lower coated layer and instead prepare a magnetic coating material by mixing and dispersing for 48 hours using a ball mill a magnetic coating material composition of below-mentioned composition, and coat so that the dried thickness of this magnetic coating material is 3 μm, and after performing alignment and drying, calendar process to form a magnetic layer for the lower layer. Form the intermediate layer in the same way as with Embodiment 1 on the magnetic layer of this lower layer, and coat the magnetic coating material which was prepared in Embodiment 1 so as to obtain a dried thickness of 2 μm, and forming a magnetic layer of the top layer in the same way as with Embodiment 1, obtain a video tape of 2 magnetic layers which pass through the intermediate layer.

Magnetic Coating Material Composition

r-Fe₂O₃ which contains Co (ave. particle diam. 0.3 μm)
100 wt. parts

Carbon black	5 wt.
parts	
Hardener	8 wt.
parts	
Polyurethane resin	7 wt.
parts	
Trifunctional low molecular weight isocyanate compound	
3 wt. parts	
Cyclohexanon	125
wt. parts	
Toluene	125 wt.
parts	

Comparative Example 1

As with Embodiment 1, but instead of omitting formation of the intermediate layer, form a video tape in the same way as with Embodiment 1

Comparative Example 2

As with Embodiment 2, instead of omitting the formation of the intermediate layer, form a video tape in the same way as with Embodiment 2.

For the video tape that was obtained using each of the embodiments and the comparative examples, using methods shown below, measure the surface roughness, video S/N, and C/N.

< Surface Roughness>

Using a Needle surface roughness meter, there was measured the center axis average roughness (Ra) of the magnetic layer of each video tape.

<Video S/N>

Using a VTR of VHS form, there was recorded and reproduced a video signal of 50% white for each video tape, and there was measurement of the noise of the reproduced signal by a color video noise measurement meter, and the S/N was calculated, and there were indicated relative values with respect to a standard tape.

<C/N>

There was recording and reproduction on each video tape of signals of simple frequencies, and analysis done using a spectrum analyzer of the reproduced signals, and the ratio of the reproduced signal to noise was expressed in dB, and the relative values with a standard tape were shown.

The results are shown in the following Table 1.

	Surface roughness (μm)	Video S/N (db)	C/N (db)
Embodiment 1	0.006	+ 3.4	+ 1.0
Embodiment 2	0.006	+ 3.6	+1.2
Comparative Example 1	0.030	+ 0.8	-1.4
Comparative Example 2	0.010	+1.2	-0.3

. The video tapes (Embodiments 1 and 2) which were obtained from this invention as clearly shown in the above-mentioned Table 1, compared to conventional magnetic tape (Comparative Examples 1 and 2) which did not have intermediate layers, had lower surface roughness, and higher video S/N and C/N, and the magnetic recording medium which was obtained according to the invention had good surface smoothness for the magnetic layer of the topmost layer and had excellent electromagnetic conversion properties.

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